

example, M. Menetrier et al., "The Second Japan-France Joint Seminar on Lithium Batteries, November 23-24, 1998, Morioka, Japan", p.83).

Examples of third oxides include complex oxides represented by the compositional formula  $\text{Li}_e\text{M}_3\text{Co}_{1-f}\text{O}_2$  (where, M3 is at least one element selected from the group consisting of Al, Mn, Mg and Ti,  $0 < e < 1.3$  and  $0 \leq f \leq 0.4$ ). Preferred among them are those which contain at least one of Mg and Ti in the place of M3 and satisfy  $0.02 \leq f \leq 0.2$  in the compositional formula  $\text{Li}_e\text{M}_3\text{Co}_{1-f}\text{O}_2$ .

The capacity is suitably maintained at high values when the aforementioned first, second and third oxides are mixed in the weight ratio of (first oxide):(second oxide + third oxide) = 20:80 - 80:20. Within the specified range, the electronic conductivity of the whole is improved and contact between particles of the first, second and third oxides is maintained in a more stable manner, so that deterioration of load characteristics with cycling can be suppressed.

The capacity is optimally maintained at high values when the aforementioned second and third oxides are mixed in the weight ratio of (second oxide):(third oxide) = 90:10 - 10:90. Within the specified range, electronic conductivity of the whole is further improved and deterioration of load characteristics with cycling is further suppressed.

The first oxide in the form of a lithium-manganese

complex oxide preferably has a mean particle diameter of 5 - 30  $\mu\text{m}$ . The second oxide in the form of a lithium-nickel-cobalt complex oxide preferably has a mean particle diameter of 3 - 15  $\mu\text{m}$ . The third oxide in the form of a lithium-cobalt complex oxide preferably has a mean particle diameter of 3 - 15  $\mu\text{m}$ . The combination thereof is most preferred. Preferably, the first oxide has a larger mean particle diameter than the second and third oxides. If the mean particle diameter of each oxide is maintained within the above-specified range, contact between particles of those complex oxides is maintained at a higher degree of occurrence to thereby improve the electronic conductivity of the mix in its entirety. Also, expansion and shrinkage are balanced more effectively between those complex oxides so that contact between particles of those complex oxides is maintained in a more stable manner. As a result, the load characteristic deterioration with cycling can be suppressed. The mean particle diameter can be determined in the same manner as described in the first aspect.

If the above-described configurations and constructions are satisfied properly, nonaqueous electrolyte secondary batteries can be provided which are highly reliable and show little deterioration of load characteristics with charge-discharge cycling.

The matters in common with the first and second aspects

of the present invention are below described as "present invention", collectively.

The battery materials other than the positive electrode material, for use in the present invention, can be selected from those known in the prior art as useful for nonaqueous electrolyte secondary batteries, without particular limitations.

Examples of negative electrode materials include lithium alloys such as metallic lithium, lithium-aluminum alloys capable of storage and release of lithium, lithium-lead alloys and lithium-tin alloys; carbon materials such as graphite, coke and calcined organics; and metal oxides having potentials more negative than the positive active material, such as  $\text{SnO}_2$ ,  $\text{SnO}$ ,  $\text{TiO}_2$  and  $\text{Nb}_2\text{O}_3$ .

Examples of nonaqueous electrolyte solvents include high-boiling solvents such as ethylene carbonate (EC), propylene carbonate (PC), vinylene carbonate (VC) and butylene carbonate (BC); and mixed solvents thereof in combination with low-boiling solvents such as dimethyl carbonate (DMC), diethyl carbonate (DEC), methyl ethyl carbonate (EMC), 1,2-diethoxyethane (DEE), 1,2-dimethoxyethane (DME) and ethoxymethoxyethane (EME).

#### BRIEF DESCRIPTION OF THE DRAWINGS